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ABSTRACT

Beginning with a review of relevant literature on learning and computers, this report focuses on a group of five second graders in the process of creating a multimedia presentation for their class. Using "StoryShow," software that combines images, sound, and text, the students took on a variety of production roles. Each one contributed at least one image and sound element to the final composition. Each task the students performed--manipulating hardware or software, choosing images from books or directing other students--was essential to the overall success of the composition, but the role of director, taken on by one girl in the group, became the key to its completion. The success of this episode was facilitated, in part, by the teacher's interpretation of how the software might be used, and a classroom environment that supported the kinds of independent and collaborative activities that the software encouraged. The research method employed in this study is micro-ethnographic; and the objectives were to understand classroom learning activities from the point of view of the participants, to describe how innovative educational tools move from design to actual use, and to show how that knowledge may be applied to future designs. (Contains 15 references.) (Author/ALF)

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APPLE CLASSROOMS OF TOMORROW

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The Negotiations of Group Authorship Among Second Graders Using Multimedia Composing Software

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ACOT Report #14

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Research

The Study

This study focuses on five 2nd graders creating a multimedia presentation with 'StoryShow,' a software application for combining images, sound and text.

Each task performed was essential but the director's role became pivotal to completion of the assignment.

Technology changes the kinds of text children interact with and the kinds of interactions children have with text when it is widely used in reading and writing.

Research literature shows that technology is interpreted according to the relationships that already existed among teachers and students before technology was introduced.

Preface

Begun in 1985, Apple Classrooms of Tomorrow (ACOT)℠ is a research and development collaboration among public schools, universities, research agencies and Apple Computer, Inc. ACOT explores, develops and demonstrates the powerful uses of technologies in teaching and learning. In all ACOT endeavors, instruction and assessment are as integral to learning as technology.

Supporting a constructivist approach to learning, technology is used as knowledge-building tools. As students collaborate, create media-rich compositions and use simulations and models, researchers investigate four aspects of learning: tasks, interactions, situations and tools. The research is formative. The findings guide ACOT staff and teachers as they refine their approach to learning, teaching and professional development. ACOT teachers and students often use the most advanced technologies available, including experimental technologies, to help us envision the future and improve the educational process.

ACOT views technology as a necessary and catalytic part of the effort required to fundamental restructure America's education system. We hope that by sharing our results with parents, educators, policy makers, and technology developers the lessons of ACOT will contribute to the advancement of educational reform.

Abstract

Beginning with a review of relevant literature on learning and computers, this report focuses on a group of five second graders in the process of creating a multimedia presentation for their class. Using software that combines images, sound and text, the students took on a variety of production roles. Each one contributed at least one image and sound element to the final composition. Each task the students performed—manipulating hardware or software, choosing images from books or directing other students—was essential to the overall success of the composition, but the role of director, taken on by one girl in the group, became the key to its completion.

The success of this episode was facilitated, in part, by the teacher's interpretation of how the software might be used, and a classroom environment that supported the kinds of independent and collaborative activities that the software encouraged.

Introduction

According to Vygotsky (1978), the tools that we use to manipulate signs — in the form of language or other symbol systems — mediate our interactions with the world and restructure our mental activity. In human societies, people perform numerous tasks with the aid of tools as simple as hammers and saws or as complex as writing systems. As people use these tools, they bring changes to both the world around them and to the psychological processes and representations that underlie the activities (Vygotsky, 1978; Martin & Scribner, 1988).

Technology — when widely used for children's reading and writing activities — is changing the kinds of interactions children have with text, as well as the kinds of texts with which they interact. New computer-based tools combine text, sound, image and video in various ways — as in videodiscs and video games — providing new methods for creating texts. In this report, we see how a multimedia composition tool designed specifically for children was used by a group of five students in a second grade classroom.

How each individual child uses a computer will always be closely connected to the social relationships existing in the classroom.

Children who play video games and watch television, have an intertextual world that stretches beyond the book, to include particular characters and stories as well as particular ways of interacting with texts.

Collaborative tools can help people produce something together that no one person could produce working alone.

How tools are designed will influence the ways students can collaborate.

Innovations and Classrooms

Any technology is conceived, developed and employed in a particular social context, and the influence it has depends greatly upon how it is used in a given environment. Putting a computer in a classroom is not likely to lead to changes in learning unless the computer-based activities relate closely to the kinds of activities already taking place in that classroom.

In Mehan's (1989) study of the use of single microcomputers in four classrooms, he describes how the technology was used in very different ways by each teacher, leading to different changes in classroom activity. Mehan argues that the social structure of the classroom is the key element in understanding how technology will be used. Although particular uses of technology may encourage participation, the most important factor is not the computer and the software, but what is done with them.

Similar conclusions are drawn by Hawkins (1987) in an analysis of Logo use by teachers and students, by Genishi (1988) who examined the use of Logo in a kindergarten classroom, and by Cochran-Smith (1991) in a review of word processing research with children. This research supports the assertion that technology is interpreted according to the relationships that exist in the classroom prior to the presence of the technology.

Writing and Technology

Most research on writing with computers has concentrated on cognitive processes in isolation from particular writing contexts (Cochran-Smith, Paris & Kahn, 1991), while research on reading and technology has focussed on Computer-Assisted Instruction, such as reading improvement software (Balajthy, 1989). Neither of these approaches seems adequate when attempting to explain how a particular technology is integrated into the culture of a classroom. The kinds of changes that may occur are not likely to be captured if the focus of research is only on individuals and does not attempt to understand the classroom environment. The manner in which an individual child makes use of a computer will always be closely connected to the presence of other children and teachers, for it is the social relationships which exist in the classroom that will help us understand how and why things happen, whether or not they involve technology.

As Cochran-Smith et al. (1991) state in their study of word processing and elementary students:

> *Learning to write with computers and learning to teach writing with computers are qualitatively different experiences from learning with pencil and paper.* (p. 1)

According to Cochran-Smith, word processing can lead to the use of new social arrangements involving collaboration and coaching, which in turn shape the theories and practices of writing in the classroom. Although there is little evidence that the quality of student writing changes when word processors are available, their study indicates that children may spend more time writing, and produce texts that are slightly longer than those created using pen and paper. What is not clear from the study is whether students who have continuous access to computers use them differently than students who may use computers once a week in a computer lab, or who have a single computer available in their classroom.

Literacy

Lemke (1989) has described literacy as knowledge about a world of texts, and making connections between them, both to understand and to be understood. Schooling can be seen as learning to master texts deemed important by a particular society. Barthes (1974) views text as just a set of potential meanings which are only realized through the reader-text interaction. This interaction is complex and greatly influenced, as Lemke notes, by other text with which a reader is familiar. For children accustomed to video games and television, their intertextual world stretches beyond the book to include particular characters and stories as

The opportunity to record and analyze the public thoughts and writing activities of students is an advantage brought on by collaborative writing.

Tools facilitating collaborative composing could be improved if designers understand what kinds of collaborations are valuable and how software design relates to use.

StoryShow was conceived to help children construct stories that incorporate images and written and oral language. However this study indicates that is not necessarily how the software will be used.

The software used a slide show metaphor. Each slide can consist of an image, text and sounds.

well as particular ways of interacting with texts.

Barthes differentiates between "readerly" and "writerly texts". The writerly text gives the reader more room to maneuver, and the reader is more actively involved in creating meaning. With readerly text, in contrast, the reader is left to accept or reject what is presented, and meaning is often overly-determined by the writer.

This distribution of power and control between text and reader, and the role it plays in how meaning is arrived at, seems a key point in understanding the reading and writing of children who are accustomed to different kinds of texts, such as video games, which may be seen as very "writerly." A child interacting with a video game has a large amount of control over what happens as the game progresses. When the same children create or read text, similar options may not always be available. When they are, as in the case of multimedia technologies and computers, children may find the kinds of interactions possible a more natural extension of video games than books or other activities available to them.

Computer Supported Cooperative Work

In a review of tools for collaboration, Michael Schrage (1990) makes a distinction between increasing communication and increasing collaboration, and emphasizes that different tools are needed for collaboration. Schrage defines collaboration as shared discovery or shared creation, and shows that the need for collaboration is great when people deal with complex problems or when people with different areas of expertise need to work together. Collaborative tools can help people produce something together that no one person could produce working alone.

How tools are designed will influence the kinds of collaboration they encourage. The desk, according to Schrage, is designed for the individual working alone. The same could be said for most computer software, which usually assumes one user with one keyboard and one mouse working on one computer. Tools for collaboration can help people develop what Schrage calls a "shared space." The shared space can be generated by people separated by time and distance, but it is through the use of the shared space that a collaboration will be shaped. Language is the primary way in which this shared understanding is developed, for as Schrage points out, language is the primary tool for collaboration.

While not primarily focused on the collaborative aspects of software design, several studies of word processing among children have considered how the use of computers for writing encourages collaborative writing. Heap (1989) points out that collaborative activity makes private cognitive processes public — students have to negotiate the use of the computer, and development of a text, through language. For research purposes, the opportunity to record and analyze the public thoughts and writing activities of students is an advantage brought on by collaborative writing. Dickinson's study (1986) on the use of a computer for writing in a first-second grade classroom focussed on the social structure that arose as the computer was used, and examined the planning, self-monitoring and response to writing that occurred as a result. In this case the computer was integrated into the pre-existing writing curriculum and treated as another tool for writing by the teacher, but its use led to more opportunities for children to talk among themselves than was possible when they wrote with pencil and paper. Both Dickinson and Heap looked at classrooms with one computer, and with word processing software designed with a single user in mind. In both cases, the cooperative aspects of composing are defined socially, and are not primary features of the writing tools in use. Students collaborated because they chose to work together and because there was a shortage of tools.

Neither of these studies provides a definition of collaborative text. Is a story written by one child with help from a computer assistant collaborative in the same way that a story jointly composed by two students is? Certainly collaboration in writing can exist at a number of levels, but if better tools to facilitate collaborative composing are to be designed, there needs to be an understanding of what kinds of collaboration are valuable, and how software/tool

This analysis discusses how students allocated composing tasks and how the social interactions that occurred when the software was used fit into the class' overall social structure. It also discusses the relationship between software design, intended use and actual use.

design relates to use in classrooms.

In this report we examine the use of *StoryShow*, a multimedia composing tool conceived to help young children construct stories that incorporate images, and written and oral language. It was designed for use by two students, although in this case it involved more, with particular features designed to encourage collaborative composing, editing, and the sharing of tasks. The primary questions for this study are:

- How does each child get to play the role of author?
- How does the sharing of tasks reflect the social structure already existing in the classroom?
- How does the intended use of the software differ from how it is actually used in the classroom?

Method

The research method employed in this study is micro-ethnographic. The overall goal of the larger ACOT study, of which this report is one part, is to understand classroom learning activities from the point of view of the participants, to describe how innovative educational tools move from design to actual use, and to show how that knowledge may be applied to future designs.

Students weren't assigned specific tasks by the teacher.

Setting

This study took place in a second grade classroom in the Silicon Valley area of California as part of long–term research conducted by the Apple Classrooms of Tomorrow project of Apple Computer, Inc. The second grade teacher chose to participate in the field–testing of *StoryShow*, which had previously been in use in the first and fourth grade classrooms of this ACOT school.

Multiple technologies in the room allowed each students to play several roles.

The teacher in this classroom, Ms. Boston, had been teaching for 29 years, including the previous three years as an ACOT teacher. She had become accustomed to teaching with technology, and had made some adjustments because of it, but she was not as eager to use new software and hardware as some other teachers in the school and preferred to have assistance when trying out new technologies.

The school population is drawn largely from middle to upper socio-economic families, with many parents taking a strong interest in their child's schooling. In Ms. Boston's class there were 27 students, approximately 70 percent Anglo and 30 percent Asian. The five students participating in this study were chosen by the teacher, and the activities were conducted during the natural course of events in the classroom.

Donnie controlled the mouse pointing device for most events during the composing process. However, technical control didn't translate into content control.

The classroom itself was unique in terms of the amount of technology available to students and teacher: eight Macintosh® computers, three scanners, a laser printer, and a MacRecorder. In addition, there were 16 Apple II GS computers, eight dot-matrix printers and two video cassette recorders with color monitors. Another Macintosh, connected to a videodisc player, was shared with another classroom.

Students used the computers for writing in journals, composing stories or drawing or creating animation. Computers were not used for playing games in the classroom. Over the course of a day, students were likely to use a computer for a total of about one hour.

Reading and writing activities were integrated in Ms. Boston's classroom. Children often read a particular type of story as a group, an additional story on their own, then wrote their own story on the same topic. The open atmosphere in the classroom allowed students to move around relatively freely, so collaboration of various kinds was likely to take place throughout the day. Collaboration might involve one student assisting another with a computer task, or with spelling, or could be a group activity with students reading aloud or acting out parts of a story.

Julie was recognized by the other students as the activity's leader and she dominated content. Students turned to her for decision-making.

Rick controlled the microphone, even when it wasn't in use. However, microphone control had little impact on content or participation. When she needed it, Julie physically took control of the microphone from Rick.

The final slide show produced by the group is evidence of the cooperative nature of the composing process, but it masks the way students arrived at the final text.

Description of multimedia composing tool

The primary activity observed and recorded in this study was the use of the multimedia composing software *StoryShow*, during one morning session in Ms. Boston's classroom. The software was developed at Apple Computer, Inc. for several months before it was introduced in classrooms. *StoryShow* was conceived to help children construct stories that incorporate images and written and oral language. As this study indicates, that is not necessarily how it will be used in classrooms.

StoryShow is presently designed to run on Macintosh computers with color monitors, integrating video capture, scanning, sound input, and text. The video, image scanning, and sound elements are provided through additional devices attached to the Macintosh — an 8 mm video camera connected to the Macintosh using a video capture board, an Apple flatbed scanner for images in books or drawn by hand on paper, and a MacRecorder for sound input. Each of these devices can be accessed directly from *StoryShow* via a mouse click.[1] The software uses the metaphor of a slide show, with each slide potentially consisting of an image, text, and sound. The resulting multimedia text can be played back on the screen as a series of images, sounds, and text, and it can be saved to a videotape which can then be replayed on a video cassette recorder at home or in school.

Initial testing was conducted informally on pairs of six and seven year old children. This was done early in the design and programming phase of the project to ensure the program was not too complex for the target audience. Additional testing continued with first and fourth graders in volunteer classrooms, and was ongoing during the time of this study.

StoryShow uses a slide show metaphor to combine text, images and sound.

Data Collection

The data for this study were collected over a five-week period and consisted of field notes from observations of classroom activity, videotapes of students working in the classroom and using *StoryShow*, a video taped trace of what students produced on the computer screen, the computer files of their work, and a taped interview with the teacher.

The students in Ms. Boston's class were initially introduced to *StoryShow* in a 60 minute demonstration. Several children participated directly, and the entire class chose pictures and sound that went into the final text. The following week a group of six children built a multimedia composition using *StoryShow*.

The students' next use of *StoryShow*, and the one reported in this study, occurred on a day when the classroom was being used as the background for a local television show about

[1] A "mouse," is an input device supplementary to a computer keyboard that facilitates the manipulation of text and images. The mouse includes a button, which when pressed or "clicked," causes an action to occur on the screen.

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Even in the cases where sounds or images were supplied by someone other than Julie, the "director," she often had the final say as to what image was used and which sounds accompanied which images.

The boys showed more interest in controlling the hardware than in actually choosing what went into the composition. Their language implied a link between device control and actual production that didn't exist.

computers and education. Students were assigned to *StoryShow* to illustrate the kinds of activities students carried out with computers. Filming for the television show lasted about 35 minutes, with some disruptions, and *StoryShow* activity then continued for an additional 90 minutes.

The student work group consisted initially of two boys, Rick and Donnie, and two girls, Julie and Amber. A third girl, Mary, joined the group near the end of the activity. All students in this group are Anglo–American with the exception of Donnie, who is Asian-American.

During data collection I participated as a technical assistant to the children, correcting problems that came up during their use of the software. I tried to refrain from providing assistance on content questions entirely, and kept my technical help to the minimum necessary to allow the children to use the software.

Data Preparation

The videotapes of children working at the computer and the trace of their interactions with the software were reviewed and categorized by the events, participant structures and content produced. I defined an event as bounded by the start of any activity designed to add a new element to the composition, and the completion or abandonment of that activity. I focused on who was operating each of the two main control devices (mouse, microphone), who provided the content during the given event, and who made the final decision on content for that event. For content, I considered the use of the three elements available in each slide — image, sound, and text.

The goal of this analysis was to understand how the students allocated composing tasks as they used the software, to understand how the social interactions that occurred while students used the software fit into the social structure of the classroom, and to consider the relationship between the design and intended use of the software, and how it was actually used by students.

Composing Episode

Participant structures were examined in two ways — software control (use of the mouse), and content control (who selects what goes into the composition and who decides what actually gets saved as part of the final product.) The students were not assigned specific tasks by the teacher, but the presence of multiple technologies allowed each of the students to play various roles. In this case, both boys gravitated towards the computer while one of the girls, Julie, took control of the content.

Donnie controlled the mouse during 37 of the 44 total events I identified in the composing process, but this technical control did not translate into control over content or turn–taking. Content was dominated by Julie, who initiated actions that started 18 new events, and decided whether or not a particular sound or image would be saved for 38 of the 44 events (often sharing the decision with others.) Julie was recognized by the other students as the leader of this activity, as they often turned to her when a decision had to be made. This was consistent with other activities in the classroom, and Julie's skill as a leader was noted by Ms. Boston both during the time the group worked with *StoryShow* and in an interview. During most of the composing process, Rick maintained control of the microphone, even when it was not in use. Control of the microphone had little impact on content or participation, and when she needed it, Julie physically took control of the microphone from Rick.

The final slide show produced by the group gives evidence of the cooperative nature of the composing process, but through the presence of multiple authors, it tends to mask the way in which students arrived at the final text.

As students progressed through the composition, more and more time was spent pre-editing. Images and sounds were rehearsed and oriented carefully before recording or capturing.

Colored icons represented actions controlling the software. In conversations, students referred more to the colors than the actions.

While composing with StoryShow was clearly an extension of the usual reading and writing activities, it also required students to manage a variety of new roles.

Even in the cases where sound or image input was supplied by someone other than Julie, she often had the final say as to what image was used or what sound went with the image. For Mary and Rick, Julie provided assistance in selecting an image and coached them on the exact content of their sounds by speaking the words herself and having the other child repeat them before attempting to record the final sound. While this might seem an act of dominating the content, in each case, Rick and Mary were not quite sure what to say or what to put in, and Julie's actions could be seen as those of a more able peer providing the scaffolding necessary for the other children to successfully complete the task.

The following example illustrates the composing process used by this group. (In each of this example, I am identified as the "Assistant"). In the first example we see how the students have structured the process themselves. They have chosen to create a series of slides using books about rabbits they have read in class.

Composing Example — Production of first slide

Speaker	What is said	Related Actions
Donnie:	Come on get some pictures. Where's the books?	Donnie using mouse
Julie and Amber get books and hold them in front of the camera		
Julie:	There it is. I want to hold it up (To Amber).	Julie takes book
Assistant:	What do you guys want to do?	
Julie:	Do the many rabbit stories of Mrs. Boston's class.	Julie sets book down
Donnie:	Get closer, get close.	
Julie:	No, why don't we hold up, why don't we hold up all of the books in front of the camera?	Julie backs away from camera
Julie:	(To Rick and Donnie) OK you guys grab a book.	
Donnie:	I'm not, I'm taking pictures. mouse	Donnie still controls
Julie:	Grab a book! (emphatically)	Amber gets a book
Rick:	And I am making sounds	

Both boys here show more interest in having control of the hardware than in actually choosing what goes into the composition. Their language — "I'm taking pictures," and "I am making sounds" imply a link between control of the devices to create the pictures and sounds and the actual production ("making") of them that didn't really exist. ('Mrs. Ellis' is the school's computer coordinator).

Speaker	What is said	Related Actions
Julie:	Grab two if you want to.	
Julie:	(To Rick and Donnie) Here, take two.	Julie hands them books
Julie:	Let's all get in front of the picture. All of these in front.	

Everyone holds up books. Julie has organized the group to take the picture.

Taking a picture involved positioning a selected image in front of a video camera and pointing to the correct icon on the computer screen. The software froze the image momentarily giving students an opportunity to quickly evaluate it.

The software was designed to save images automatically, but offered a choice of saving or re-recording sound.

Image editing generally took place before it was captured. Images once in the computer were rarely rejected or re-taken.

Speaker	What is said	Related Actions
Julie:	Uh oh, I have three.	
Rick:	Let's call this the introduction.	
Julie:	Hey no you guys...(unintelligible)	
Rick and Donnie are holding their books up and they are blocking everything else		
Julie and Amber:	Rick!	
Julie:	Can you hold this one?	
Rick:	It won't get, it won't fit.	
Julie:	Well, we all put in.	Donnie stands up.
Julie:	Donnie, your face is in the way. (laughing)	
Julie:	Donnie, put the other one, the Peter Rabbit book in the front.	
Donnie:	How am I gonna take a picture though?	
Julie:	Let me see?	
Assistant:	Who's gonna click the mouse?	
Donnie:	I will.	
Julie:	Mrs. Ellis.	Julie leaves
Julie:	Mrs. Ellis, could you, could you, could you?	Points to computer
Rick:	All right, do it.	
Julie:	Donnie, put up both of them, Mrs. Ellis's gonna do it.	
Donnie:	I can hardly do this.	
Julie:	Donnie, put up both of them. Put 'em together.	
David:	Ah, what's this? This is crazy	David wanders over

David was not part of the group but happened to walk over to that part of the classroom as they were working.

Speaker	What is said	Related Actions
Julie:	Are they both in the picture?	
Rick:	No.	
Mrs. Ellis:	There.	Standing next to computer
Donnie:	Take a picture.	
Mrs. Ellis:	Ready?	
Julie:	No, wait. Can you see all the books?	

However, sounds recorded for each slide were more often rejected and re-recorded. For the final slide, students recorded the sound six times before saving it.

Over the years, the teacher changed her teaching style to better suit her students, who commonly use interactive technologies such as video games and computers as well as the visually compelling medium—television.

Using as many different teaching methods became important to the teacher because one child might tune out sound but respond well to visual information, while another has the opposite reaction.

This is an example of the sort of attention to content and editing that took place, primarily as initiated by Julie, during the composing process. As they progressed through the composition, more and more time was spent pre–editing, that is, images and sounds were rehearsed or oriented carefully before recording or capturing.

Speaker	What is said	Related Actions
Assistant:	Now click on the face, the face.	
Mrs. Ellis:	Where's the mouse? What face, which face?	Couldn't find cursor
Assistant:	On the yellow.	
Donnie:	This one. (points to yellow icon of a face)	
Mrs Ellis:	OK on the yellow. Got it.	

The students referred more to the colors of objects on the screen than to the icons which represented the actions that would be initiated by clicking those objects with the mouse.

Speaker	What is said	Related Actions
Mrs. Ellis:	Ready? Tell me when?	
Julie:	No, we don't have all the books in.	
Mrs. Ellis:	There...now. Go.	Makes adjustments w/books
Picture is taken and appears on the screen after about five seconds		
Donnie:	Do you like that?	Using mouse
All:	Yeah!	

While composing with *StoryShow* can be seen clearly as an extension of the reading and writing activities usually carried out in class — reading stories and then writing about them or creating original stories on the same topic — it also required that students manage a variety of new roles. Julie initiated the event by distributing books and positioning the other students in front of the camera, and it was her idea to show several books in the picture as a way to capture what this composition was about — "The Many Rabbit Stories of Mrs. Boston's Class." However, the successful completion of the image required the cooperation of each student as well as the assistance of the school computer coordinator (Mrs. Ellis) who was in the room to help with the film crew. The process of taking the picture involved selecting an image, framing it by arranging people and objects in front of the camera, then capturing the image by clicking the mouse on the appropriate button on the screen. At this point the captured image freezed momentarily on the screen, where it could be evaluated by the students. For each slide in this example, what might be described as editing of a slide took place before the image was captured. Once an image had been put into the computer, it was usually saved as–is and rarely rejected or retaken. Sounds recorded for each slide in the show were more often rejected and re–recorded.

It is interesting to note that the way sounds and images were designed to be processed by the software, paralleled their use by the students. Recorded sounds were immediately played back by the computer, giving students the choice of saving or re–recording the sounds. For the final slide in this example, students recorded the sound six times before saving it. The software originally worked the same way for sound or images: once recorded or

Julie began the practice of discussing the sound first, then practicing it before attempting to record it. Immediate feedback from the computer seemed to make sound editing easier.

captured, the sound or image would automatically get saved into a bank of available sounds and images for later placement. Modification of the sound input facilitated editing by forcing a choice to save or re–record the sound.

The use of a trial run for sounds seems to have developed as a result of hesitations which came up during most of the recordings during the first session. Initially, the sounds were generated on the fly, as they were recorded. During a second session, Julie began the practice of discussing the sound first, then practicing it before attempting to record it. The immediate feedback from the computer seemed to make this editing easier, as children heard their work right away, and then had the option to save it or record it again.

Another curious aspect of the use of *StoryShow* is the gender–related differences in their chosen roles. Donnie and Rick were more interested in having control of the computer through the mouse and microphone, and seemed less interested in adding content to the composition. Julie initiated the turn–taking that allowed everyone to have a role in content, and although both Julie and Amber created two slides each, there was no resistance to this from Rick or Donnie, who each created one. The same orientation to the composing process was apparent in other episodes in which these students were involved, with both boys focused on controlling hardware while Julie had control of content and orchestration.

The way StoryShow was used related closely to the classroom's social organization—especially in the roles students played.

Teacher and Technology

In this classroom, as in the first and fourth grade classes, the way *StoryShow* was used related closely to the social organization of the classroom, especially in the roles students played, their freedom to move around, and ways of working: cooperatively, independently, or for an audience. While Ms. Boston stated "I'm not terribly comfortable with technology but I've gotten way more so," she also noted that technology, both inside and outside her classroom, had had an effect on the way she taught. At the outset of the ACOT program, Ms. Boston maintained a "lecture-oriented" teaching practice. Students were allowed to become familiar with the computer in a limited way, but it was mainly used to tutor or drill individual students working alone. Over the years, however, she changed her teaching style to better suit her students, who commonly use interactive technologies such as video games and computers, as well as the visually compelling medium of television, outside the classroom. This led her to involve students in more physical ways in the classroom, using dramatization of stories where students act out particular roles within a text, or choral speaking, where students share in the reading of books. In her opinion, a child might tune out sound but respond well to visual information, or vice versa, and providing as many opportunities as possible became important to her. This change in teaching style, Ms. Boston remarked, is in part:

Independent work in this classroom was common. Students also worked in small groups, helping each other with both technology, and non-technology activities.

> *...Because once again I'm in competition with what's going on outside the classroom, so I think I try to change activities so they're involved. Without technology, they're involved doing dramatization or in choral speaking or in coming up and doing an example. But physically they're involved because I think physically they're involved in a lot of things outside the classroom.*

An additional change was that the computer was no longer studied for knowledge of its components or functions. Ms. Boston's students were already tutored in computer basics in the first grade, so most were already familiar with the keyboard and had begun to master touch typing.

Independent work in Ms. Boston's classroom was common. They wrote daily journals on the computer, and they also helped each other by proofreading and offering suggestions. Students also worked in small groups on computer-oriented tasks and they helped each other in both technology and non-technology activities. Ms. Boston used a process-oriented approach to writing, with a chart on the wall listing various steps in the writing process as a guideline for children — pre-writing, writing, revision, etc. In this classroom, the process of

Different kinds of classrooms and teaching approaches led to different kinds of student collaborations.

revision seemed to match Cochran-Smith (1991) — students corrected errors and added to the end of texts, but were less likely to move text around or change parts of sentences. Ms. Boston said it was "important that children write every day," and student work on journals and in writing their own stories was something that went on every day in her classroom. Most of the computer use involved children using painting or writing programs at individual computers, with various kinds of helping and sharing of information, both about content and about how to use the computer.

One of the original goals of the design of *StoryShow* was to build a composing tool that could be easily used by two students working together on the same project. Choosing projects and students was left to the teachers involved in this study, and one result was that different kinds of classrooms and teaching approaches led to different kinds of collaborations among students using *StoryShow*.

In Ms. Boston's class, all student editing happened during input. Software features allowing movement of slides and slide elements were not used at all by this group.

Despite limited experience using StoryShow, students had little trouble importing images and sounds.

Providing easy to use editing tools didn't encourage editing. The writing tasks students do need to require editing.

In Ms. Boston's class, all student editing was at the point of input. Features in the software designed to enable the movement of slides and slide elements were not used at all by this group. These features occupied large amounts of development time, and were included to make possible the sorts of higher-level editing paralleled by the copy, cut, and paste features of word processors. Perhaps not surprisingly, although this group of students has highly developed skills for using the computer, their editing/revision strategies tended to be surface level only. Even in writing with word processors they often made spelling corrections or added text to existing paragraphs or corrected sentences as they wrote them, but didn't move things around, or attempt to completely rewrite existing sentences. Ms. Boston said that students did do more revision of their work with the computer, but most of that activity centered around correcting spelling errors. As a result, it is not surprising that the editing features built in to *StoryShow* were not used. Again, classroom practice was the primary factor in how the technology was actually used. A useful question to consider is how existing practice might be successfully combined with technology to encourage particular types of writing and composing activities that are seen as desirable, such as higher-level editing and revision. Attempting to encourage editing by providing tools to facilitate it is inadequate — the tasks students engage in need to require that editing be a desirable part of the process.

While existing classroom activities did not encourage much editing or revision of story elements, the classroom structure did seem to support the sort of independent, student-centered group work that the *StoryShow* activity permits, and students' experience with computers as well as working with each other seemed to facilitate the group production of text.

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Students' experience with computers as well as working with each other seemed to facilitate the group production of text.

They were accustomed to sharing tasks in large group productions such as choral readings, and they had experience writing and sharing stories with the rest of the class. In the other two classrooms, students worked only in pairs, and where the pairs were accustomed to working together things went relatively smoothly, but when they were unfamiliar with each other's styles, the process was not as smooth. A larger group makes this kind of individual conflict less likely, although it also complicates the distribution of power in the composing process, as this report shows.

Knowing their work would be shown to an audience played a role in how students structured their composition.

Overall, the presence of an integrated reading-writing program where students were accustomed to writing about things they read and sharing that with other students, as well as working together, seemed to facilitate the use of *StoryShow* in interesting ways. This activity was seen as valuable by the students involved, in part because they were doing something that other students were not, but also because their work was presented to the whole class with the lights out. Knowing that an audience existed for their composition seems to have played a role both in the structure of their composition — an introductory slide announcing the content and a final slide identifying each author — as well as in their emphasis on getting each sound right and making sure it was clearly audible. Their final slide took six tries before the sound was deemed acceptable by the group.

Language is the medium through which students shared power and content. Technology control was only a secondary feature of the collaborative process.

While *StoryShow* was designed for two children working together, it really doesn't provide any special tools to enhance the collaboration. Language, as Schrage (1990) noted, is ultimately the primary tool of collaboration. Certainly language is the medium through which students in this study shared power and content. Control of the technology was only a secondary feature of the collaborative process. Language was used to direct the content and the operation of the software, to accept or reject images and sounds that became part of the composition, and to plan each slide as it was constructed. While the software can be seen as the focus of the process, language was really the tool of collaboration.

Software Design

Although students had very limited experience using StoryShow, they manage the process of importing sounds and images with little difficulty.

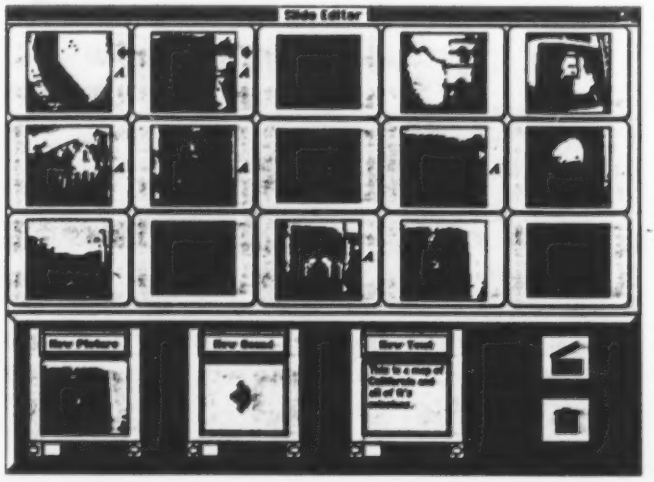
Although students had only limited experience using the software, they were able to manage the process of importing images from the video camera and record sounds without much difficulty. To a large extent, the software did not get in the way of their activity. However, there were several instances where moving from one "mode" to another was confusing. For example, they employed a consistently linear process when constructing their composition — they moved from slide #1 through to slide #9 one by one, first capturing an image and then adding a sound to the image. No text was used for any slides. Breakdowns, defined as instances where production or manipulation of an element was interrupted by a problem with the software, seemed to occur when students moved from image capture to sound recording, a procedure which involved clicking on specific buttons to close the video camera and return to the slide editing area. On several occasions students opened a new window to capture an image on one monitor, then moved back to the main slide window without closing the capture window, causing the software to function incorrectly. In addition, this movement necessitated the dragging of a screen window from one monitor to another each time. This process is initially very disorienting, as it involves moving an object between two screens which are physically separate. When the object is dragged to the right edge of one screen, it then appears on the left edge of the second screen, which is several inches away from the first screen. Use of the second screen was necessary to allow videotaping of screen interactions as well as the use of the video capture for images. A more elegant solution might be to incorporate the image capture directly into each individual slide to avoid the mode switching and perhaps facilitating faster construction of the compositions.

Because these children did no editing other than to reject particular images or sounds and retake or re–record them, the switching from capture to edit mode served no purpose other than to confuse them.

Because these children did no editing except for rejecting certain images or sounds and re-taking or re-recording them, the software feature allowing users to switch between capturing and editing mode confused the students.

A second feature of the software which was not used at all again relates to the modality of the slide images. An initial screen shows 15 slides in small form — images are approximately 1/20 original size, and text and sounds appear only as icons on individual slides.

The software shows 15 slides in small form. Images are 1/20th original size and text and sounds appear only as icons on individual slides. Children never 'clicked' on these slides to view or hear the slide because editing decisions were made at the point of import.



To view or hear the slide, one can double–click the mouse on the image or part of the slide. In this study, that operation was not performed even once. Editing decisions were made at the point of import — when an image was grabbed using the camera and video capture software/hardware, it was either accepted or rejected. The same procedure was followed for sounds.

Again, redesign of the software could make this process easier by eliminating the use of the small slides and filling each screen with the original size image along with the image capture controls, sound controls and text area. Image, not text, predominates in the design of the software, so a redesign that incorporates text more prominently might increase the use of written language by younger children.

If the software were re-designed so small slides were replaced by large images with image, sound and text controls, the editing process may become easier.

With most software, files are saved with names given by the user of the software. Instead, *StoryShow* generates names for each image, sound, and text, and each of these objects are kept as small icons at the bottom of the screen to be added to a specific slide by dragging the image up to the slide. For images and text, this works well, as the icon usually provides a visible clue as to what the entire image or text is — a shrunken picture or the first few words of the text. For sounds, the visual representation offers no clue as to the content, making browsing through sounds a tedious process of listening to each one entirely. What is needed is a way to sample the first two or three seconds of the sound. Lacking this, the size of the sound is represented by icons which show more waves coming out of a speaker to indicate longer sounds. (See figure below.)

shorter sound

longer sound

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The software was designed for images. A re-design that incorporates text more prominently might increase the children's use of written language.

The iconic delineation on stored sounds offered no clue about content, making sound browsing tedious. An ability to sample initial seconds of sounds might encourage browsing.

Features enabling students to collect, browse and assemble tended to be ignored by students. All composing was done one slide at a time.

This feature, and others with a "collect-browse-assemble" orientation tended to be ignored by students. Instead, all composing was done one slide at a time. A picture was captured and saved, followed by a sound. This eliminated the need to browse through images and sounds, and argues for a redesign of the software to better fit the composition style of the students.

Collaboration and StoryShow

As a collaborative tool, *StoryShow* functions reasonably well in an environment where collaboration is already common. The presence of multiple input devices, and multiple roles for participants, allow groups of up to five or six children to work together on a composition. What is clear is that the collaboration is tied to the social setting in which the software is used and is not an outgrowth of any particular design features aimed at encouraging collaboration.

In a first grade classroom where students were less accustomed to working independently and were paired as a result of completing an assignment first rather than by choice, the software was used one at a time, with each child creating a single slide as the other watched or assisted with reading of the text, or correcting spelling errors on the screen. This kind of collaboration is similar to that among the first graders using word processing software described by Heap (1989). When one student has final control over content, whether for the text of a story or for the image, sound, and text in an individual slide, it is not clear that another student assisting with input or corrections is really collaborating as a coauthor. To call such interactions collaboration may honor the work of the assistant too highly. Collaboration at the level of content seems a different matter than sharing the task of typing. In Heap's study and others like it, collaboration is part of the social structure of the classroom that permits it to happen, but it often occurs because there is a limited amount of technology, often one computer per classroom. Such a set-up almost requires that children work together if enough students are to master the computer, on whatever software is available. Designing software specifically for collaborative work will require attention both to the writing practices of classrooms as well as an understanding of the kinds of social relationships that exist among students and teachers in classrooms.

This report was part of a larger study of the introduction of multimedia software designed for use by pairs of children. In each of the three classrooms where the study was conducted, students used *StoryShow* to construct presentations rather than stories, and in Ms. Boston's classroom, students worked in groups of four to six rather than in pairs. A number of factors contributed to how the software ultimately was used, including how it was interpreted by individual teachers, how well it fit into the ongoing reading and writing activities of the classroom, and how students chose to use it. While the software design can be seen as successful from a technical perspective because students in first, second, and fourth grades were all able to use it with very limited instruction, a closer look at actual use suggests that technical mastery is not closely tied to using software in ways that are interesting or involve children in reading and writing in new ways.

The presence of advanced technology for creating multimedia compositions requires curriculum support that gives students a sense of how to combine different media effectively. Given the extremely limited presence of multimedia composing tools in schools, it is unlikely to expect teachers to easily integrate such tools into classrooms which still tend to focus on paper as the primary medium of communication, whether as part of writing, drawing, or word–processing activities.

Software designed for particular audiences and tasks will be used in ways that are supported by the context rather than by the software. In this case, what mattered most was not

While software design can be seen as successful from a technical perspective because first, second and fourth graders used it after limited instruction, technical mastery isn't closely tied to using software in ways that are interesting or involve children in reading and writing in new ways.

What matters most isn't the amount of technology available, but a learning environment that supports independent and collaborative activities.

How a new technology is used owes as much to the on-going activities of the classroom as it does to any particular technology feature.

the presence of expensive computer hardware and the software to allow students to create multimedia compositions, but a classroom environment which supported the kinds of independent and collaborative activities that the software made possible. Without a supportive environment, the software was little more than an object of fascination for bringing together a variety of new technologies, and permitting students to replicate their work in a new medium.

Discussion

As Mehan (1989), Cochran-Smith (1991), Hawkins (1987) and Genishi (1988) have shown, technology is not always the key element when considering how a particular hardware or software innovation actually gets used by students. The classroom is a social environment with a variety of relationships, norms, and practices which exist prior to the introduction of a new technology. How a new technology is used owes as much to the ongoing activities of the classroom as it does to any particular features of the technology.

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Note: *StoryShow*, the multimedia software used in this study, was developed at Apple Computer, Inc. by the author, Brian Reilly, based on an original concept by David C. Dwyer Ph.D., project manager and principal scientist of Apple Classrooms of Tomorrow.

Note: All names in this report are pseudonyms.

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